The opinion in support of the decision being entered today is *not* binding precedent of the Board.

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte THEODORE I. KAMINS, YONG CHEN,
and PATRICIA A. BECK

Appeal 2007-2983
Application 10/029,583
Technology Center 1700

Decided: August 3, 2007

Before BRADLEY R. GARRIS, PETER F. KRATZ, and
LINDA M. GAUDETTE, *Administrative Patent Judges*.

KRATZ, *Administrative Patent Judge*.

DECISION ON APPEAL

This is an appeal from the Examiner's final rejection of claims 1-5, and 7-48, the only claims that remain pending in this application. We have jurisdiction pursuant to 35 U.S.C. § 6.

Appellants' invention is directed to a method for forming at least one nanopore useful for forming a mold for deposition of a material or for aligning molecule(s) in fabricating electronic devices. Claim 1 is illustrative and reproduced below:

1. A method for forming at least one nanopore for aligning at least one molecule for molecular electronic devices or for forming a mold for deposition of a material, comprising:

(a) providing a substrate having a first major surface and a second major surface, substantially parallel to said first major surface;

(b) forming an etch mask on said first major surface, said etch mask comprising at least one nanoparticle;

(c) directionally etching said substrate from said first major surface toward said second major surface, using said etch mask to protect underlying portions of said substrate against said etching, thereby forming at least one pillar underneath said etch mask, wherein said directional etching is carried out using reactive ion etching;

(d) forming a layer of insulating material on said etched substrate, including around said at least one pillar and at least partially covering said at least one pillar; and

(e) removing said at least one pillar to leave at least one said nanopore in said insulating layer.

The Examiner relies on the following prior art references to show unpatentability:

Deckman	US 4,407,695	Oct. 4, 1983
Jun	US 5,393,373	Feb. 28, 1995
Brandes	US 5,900,301	May 4, 1999

Hatakeyama	US 6,010,831	Jan. 4, 2000
Kikuchi	US 6,379,572 B1	Apr. 30, 2002

Claims 1, 2, 5, 7, 8, 10-13, 23, and 47 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Kikuchi in view of Deckman. Claims 3, 21 and 22 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Kikuchi in view of Deckman and Hatakeyama. Claims 9, 14-20, 24-26, 28-46, and 48 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Kikuchi in view of Deckman, Hatakeyama, and Jun. Claims 4 and 27 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Kikuchi in view of Deckman, Hatakeyama, Jun, and Brandes.

We refer to the Brief and Reply Brief, and the Answer for a complete exposition of the opposing viewpoints of Appellants and the Examiner with respect to the rejections maintained by the Examiner.[1] We have considered the rejected claims separately to the extent that the claims are separately argued in the Brief in a manner consistent with 37 C.F.R. § 41.37 (c)(1)(vii). Of course, "[a] statement which merely points out what a claim recites will not be considered an argument for separate patentability of the claim" (id.). We affirm the stated rejections.

Rejection over Kikuchi and Deckman

Appellants argue claims 1, 2, 5, 7, 8, 10-13, and 23 together as a group (Br. 6-8). Thus, we select claim 1 as the representative claim on which we decide this appeal for this claim grouping.

[1] Our references to the Brief and Reply Brief herein are to the Brief filed on September 27, 2005 and the Reply Brief filed on March 20, 2007.

The Examiner has found that Kikuchi discloses a process corresponding to the process of representative claim 1 except for describing that the spherical particles serving as an etch mask have a nanoparticle size and that the etching step of the layer/substrate beneath the etch mask involves directional etching using reactive ion etching. According to the Examiner, Deckman discloses nanoparticle size masks and directional etching, including the use of a reactive ion etching technique; that is, chemical etching using reactive atoms or radicals (Answer 5 and 6).

The Examiner has essentially determined that it would have been obvious for one of ordinary skill in the art to employ such nanoparticles as the etch mask in Kikuchi and to use reactive ion etching during the etching of Kikuchi for forming a pillar underneath each particle etch mask as taught by Deckman to be known techniques for masking using particle masks and for etching using reactive ions to obtain the expected results associated therewith (id).

Appellants contend that there is no suggestion for combining the references and that, even if combined, the combined teachings of the applied references do not teach or suggest a method for the formation of one or more nanopores for aligning at least one molecule therein. Moreover, Appellants contend that Deckman does not disclose the reactive ion etching, one of the claim features on which Deckman is relied on for by the Examiner.

Thus, the principal issues in this appeal concerning the propriety of the Examiner's rejection of representative claim 1 are: Have Appellants identified reversible error in the Examiner's obviousness rejection of representative claim 1 by the assertion of (1) a lack of combinability of Kikuchi and Deckman, or, even if combinable, (2) by alleging the failure of

the references to teach the claimed nanopore(s) and/or to suggest reactive ion etching as an obvious etching option?

We answer these questions in the negative and affirm the Examiner's rejection of representative claim 1 and claims 2, 5, 7, 8, 10-13, and 23 grouped together therewith.

At the outset, we note that representative claim 1 is not drawn to a molecular electronic device. Likewise, representative claim 1 is not limited to a method for making a molecular electronic device. Rather, appealed claim 1 is directed to a method for forming a nanopore using directional etching with an etch mask made of at least one nanoparticle. Appellants describe commercial particles available in sizes of from about 2 nm to 250 nm as being suitable for use as an etch mask in a best mode of their process (Specification 4). Thus, the claimed method of forming nanopores would have been understood by one of ordinary skill in the art as being inclusive of forming pores up to at least about 250 nm in cross-section.

The Examiner has correctly found that Kikuchi discloses a method for forming micropores in an insulating layer (20/64) using microspheres as masks for etching (Answer 3-5; Kikuchi; Fig. 1, Fig. 6A- Fig. 10B and col. 4, l. 57 – col. 5, l. 55). The Kikuchi method corresponds to the claim 1 method with the exception of explicitly requiring nanoparticle size microspheres as masks such that the micropores formed are of a nanoscale size and with the further exception of specifying directional etching using reactive ions. However, Kikuchi teaches that small feature sizes are desirable (col. 2, l. 1-6); hence, it would have been obvious to one of ordinary skill in the art at the time of the invention to use smaller size mask particles to form smaller pores for the ultimate obtainment of the smaller

feature sizes (for example, gate emitter openings) desired by Kikiuchi. In this regard, the Examiner refers to Deckman for a teaching that smaller size mask particles of a nanoparticle size are known to be available for use as masks for etching (see, e.g., Deckman; col. 6, ll. 25-43). Moreover, the Examiner relies on Deckman for showing that etching with reactive ions is a well-known etching method, which would have been obvious to use in Kikuchi to obtain the expected benefits of using such a known etching technique (Deckman, col. 1, ll. 46-52). We note that the test for combining references is not what the individual references suggest, as if applied alone. Rather, the test is what the combined teachings of those references would have suggested to those of ordinary skill in the art. *In re Keller*, 642 F.2d 413, 425, 208 USPQ 871, 881 (CCPA 1981). *See also, In re Sneed*, 710 F.2d 1544, 1550, 218 USPQ 385, 389 (Fed. Cir. 1983) ("[I]t is not necessary that the inventions of the references be physically combinable to render obvious the invention under review.").

In the face of the combined teachings of the applied references as set forth above and in the Answer, Appellants' contentions concerning a lack of suggestion for the claimed combination is not persuasive as Kikuchi furnishes more than adequate reasons for one of ordinary skill in the art to seek out smaller mask particles, as shown to be available in the prior art, for forming smaller pores and resultant feature sizes. Moreover, Appellants' arguments to the effect that the applied references would not teach one of ordinary skill in the art to use reactive ion etching and to form nanoscale pore sizes are not persuasive for reasons advanced above and in the Answer. In this regard, Deckman clearly discloses etching with reactive radicals (ions) to be an available chemical etching technique when using small

particle masks and further discloses that the particles may be of a nanoscale size. Furthermore, Kikuchi shows how the use of small particle masks and etching can be combined to form small pore sizes in a layer. "The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results." *See KSR Int'l Co. v. Teleflex Inc.*, 127 S.Ct. 1727, 1739, 82 USPQ2d 1385, 1395 (2007).

Claim 47

Regarding separately argued dependent claim 47, Appellants additionally argue that claim 47 requires that the method for forming the nanopore includes the further provision of furnishing a molecule therein (Br. 14). Regarding this argued claim limitation, we note that Kikuchi teaches that the pore formation process is ultimately used to form a hole in an insulator layer (20, Fig.1A) that has an emitter (34, Fig. 1A) furnished therein. The emitter emits electrons. Appellants have not fairly explained how the provision of such an emitter is not the provision of at least one molecule in the pore opening. In this regard, claim 47 does not require that each nanopore includes only one molecule. *See In re Pangrossi*, 277 F.2d 181, 184-85, 125 USPQ 410, 413 (CCPA 1960).

For the reasons set forth above and in the Answer, we affirm the obviousness rejection of claims 1, 2, 5, 7, 8, 10-13, 23, and 47 over Kikuchi and Deckman.

Rejection over Kikuchi, Deckman, and Hatakeyama

Appellants argue claims 3, 21, and 22 as a group (Br. 8-10). Thus, we select claim 3 as the representative claim.

Dependent claim 3 further requires that the nanoparticles used as a mask have an average particle size of around 1 to 10 nm.

In addition to the arguments made against the Examiner's rejection of independent claim 1, Appellants note that Hatakeyama is directed to the formation of nanoscale cones not the formation of pores. Appellants maintain that the Examiner is selecting bits and pieces from unrelated prior art in asserting that the mask particle sizes of claim 3 would have been obvious to employ in Kikuchi's process.

The difficulty we have with Appellants' argument is that Kikuchi, as we explained above, provides the incentive for one of ordinary skill in the art to employ smaller mask particles to form smaller pores and ultimately smaller feature sizes. Here, Appellants have not fairly established why one of ordinary skill of the art would not have found it obvious to employ smaller spheres or particles on the order of 10 nm in size for masking in the process of Kikuchi in light of Kikuchi's desire for small feature sizes, given that such particles are readily available for use as an etching mask as shown by Hatakeyama (Hatakeyama; col. 2, ll. 41-49). In this regard, we note that the Examiner is not relying on Hatakeyama for a teaching as to making a particular feature or for reactive ion etching but rather for the capability of micro fabricating with nanoscale masking particles and etching (see, e.g., Hatakeyama; col. 5, ll. 40-53). Rejected claim 3, for example, is not limited to a process for making a particular device after a pore is formed as evidenced by the open "comprising" transitional term used in claim 1, from which claim 3 depends. As such, much of the argumentation furnished by Appellants in the Brief appears to be misdirected. On this record, we affirm the Examiner's obviousness rejection of claims 3, 21, and 22.

Rejection over Kikuchi, Deckman, Hatakeyama, and Jun

Claims 9 and 14-20

Appellants argue these rejected claims as a group and make substantially the same arguments made against the Examiner's rejection of claims 3, 21, and 22 above (Br. 11). Thus, we select claim 9 as the representative claim. We note that rejected representative claim 9 depends directly from claim 1 and requires insulation material being formed by chemical vapor deposition (CVD) or liquid-phase techniques. Thus, Appellants' reliance on their arguments against the Examiner's use of Hatakeyama for teaching small nanosize particles as masks as set forth in the previously discussed rejection fails to establish reversible error in the Examiner's rejection of representative claim 9 because claim 9 does not require about 1-10 nm size particles (Br. 11). Moreover, Appellants do not otherwise contest the Examiner's reliance on Jun for teaching a CVD insulation deposition feature in the rejection of representative claim 9. It follows that, on this record, we shall affirm the Examiner's obviousness rejection of claims 9 and 14-20.

Claims 24-26, 28-46, and 48

Appellants argue claims 24-26 and 28-46, as a group (Br. 11-12). We select claim 24 as the representative claim on which we shall decide this appeal as to this claim grouping. We consider dependent claim 48 separately to the extent this claim has been separately argued (Br. 14).

Representative claim 24 is drawn to a method wherein at least one nanopore is formed using at least one nanoparticle mask and directional

etching followed by placing at least one molecule in the at least one nanopore.

As discussed above, Kikuchi discloses/suggests a method for forming a small micro-pore using microspheres as masks and etching with steps substantially corresponding to the claim 24 steps but for the required nanoparticle size mask and nano-size pore. The Examiner takes the position that the claim 24 requirement for dispersing at least one molecule in the pore that is made is inclusive of dispersing more than one molecule in the pore. In other words, the Examiner seemingly takes the position that the use of the pores formed by Kikuchi for ultimately placing other materials therein for making a device (such as the emitters thereof or some other material) would have been obvious to one of ordinary skill in the art from the combined teachings of the applied references, including Jun. Such a modified method is within the scope of representative claim 24 because claim 24 is not limited by the types or amounts of materials deposited in the pores that are formed.

Appellants' arguments against the Examiner's rejection of representative claim 24 centers on their contention that the claimed invention is directed to a molecular device rather than a semiconductor device as the applied references are generally directed toward.

We do not find that contention and the myriad arguments that depend on such a claim construction for rejected claim 24 persuasive (Br. 11-12 and Reply Br. 2-4). This is so because representative claim 24 does not require the preparation of a molecular electronic device.[2] Rather, Claim 24 requires

[2] Indeed, in the event of further prosecution of this subject matter before the Examiner, the Examiner should review Appellants' Specification to determine whether or not the Specification, as filed, completely describes

the dispersal of at least one molecule in a pore that is formed by the method steps recited therein without any constraints on how one or more molecules are dispersed in or added to the pore. As we noted above with respect to claim 47, Appellants have not fairly explained how the provision of an emitter in Kikuchi is not the provision of at least one molecule in the pore opening. In this regard, representative claim 24 does not require that each nanopore only includes a single molecule. As such, Appellants have not established reversible error in the Examiner's rejection based on the arguments set forth in the Brief and the unsubstantiated and irrelevant

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and/or enables the complete preparation of a particular molecular electronic device via the claimed method, much less a general method for preparing a variety of such completed molecular electronic devices to the extent that the claimed subject matter may be amended to require the formation of such a device. In this regard, Appellants briefly discuss two widely differing prior art techniques, and alleged shortcomings thereof in forming spaced holes in a substrate for placement of molecules therein (Specification 1-2). Then, Appellants describe their claimed method for forming nanopores for deposition of materials therein, or for spacing or separating molecules therein. In this regard and in the event of such further prosecution, the Examiner should determine if Specification paragraphs 0031 and 0032 furnish enough detail as to how the pillars are selectively etched to form the nanopores for compliance with § 112, first paragraph requirements. Also, for example, the Examiner should determine if Specification, paragraphs 0033-0036, including the brief reference to unidentified emerging teachings therein together with the remaining portions of the Specification satisfies the § 112, first paragraph requirements for an enabling disclosure in making a workable molecular electronic device with molecules capable of switching in the presence of an electronic field. We note that no Examples of the preparation of a workable molecular electronic device, much less one made according to the claimed method, are furnished in the Application Specification, as filed.

contentions respecting differences between molecular electronic devices and semiconductors as presented in the Reply Brief.

Claim 48

Concerning separately argued claim 48, the recited transitional term "contains" leaves the pore open to the containment of other material besides the recited one molecule for the same reasons we expressed above with respect to separately rejected claim 47.

It follows that we shall sustain the Examiner's obviousness rejection of claims 9, 14-20, 24-26, 28-46, and 48 over Kikuchi in view of Deckman, Hatakeyama, and Jun on this record.

Rejection over Kikuchi in view of Deckman, Hatakeyama, Jun, and Brandes

Rejected claim 4 depends from claim 1 and rejected claim 27 depends from claim 24. Each of claims 4 and 27 requires that the at least one nanoparticle used as a mask in the claimed method is "an inorganic crystalline core covered with an organic layer" (claim 4 and claim 27). Appellants acknowledge that these types of nanoparticles were commercially available at the time of filing of this application (Specification ¶0021). In this regard, Kikuchi discloses that the particulate spherical masks can be made from a variety of different materials (Kikuchi; col. 4, ll. 24-26). Consequently, even if we could agree with Appellants that Brandes does not teach or suggest their claimed organic coated inorganic crystalline core particles, such arguments are not persuasive of reversible error in the Examiner's rejection in that Appellants have acknowledged the commercial availability of organic coated - inorganic crystalline core particles and one of

ordinary skill in the art would have readily recognized the utility thereof in the method of Kikuchi given that Kikuchi is concerned with making fine feature sizes. Thus, the use of such small masking particles as Appellants acknowledge to be commercially available would have been recognized by one of ordinary skill in the art as being useful as particle masks in Kikuchi's process. It is axiomatic that admitted prior art in an applicants' Specification may be used in determining the patentability of a claimed invention and that consideration of the prior art cited by the Examiner may include consideration of the admitted prior art found in an applicants' Specification. *In re Nomiya*, 509 F.2d 566, 570-571, 184 USPQ 607, 611-612 (CCPA 1975).

Thus, we shall affirm the Examiner's obviousness rejection of claims 4 and 27 on this record.

CONCLUSION

The decision of the Examiner to reject claims 1, 2, 5, 7, 8, 10-13, 23, and 47 under 35 U.S.C. § 103(a) as being unpatentable over Kikuchi in view of Deckman; to reject claims 3, 21, and 22 under 35 U.S.C. § 103(a) as being unpatentable over Kikuchi in view of Deckman and Hatakeyama; to reject claims 9, 14-20, 24-26, 28-46, and 48 under 35 U.S.C. § 103(a) as being unpatentable over Kikuchi in view of Deckman, Hatakeyama, and Jun; and to reject claims 4 and 27 under 35 U.S.C. § 103(a) as being unpatentable over Kikuchi in view of Deckman, Hatakeyama, Jun, and Brandes is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a).

AFFIRMED

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